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Takuya Hirano

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EXAMINER

PICH, PONNOREAY

ART UNIT

PAPER NUMBER

2135

DATE MAILED: 03/15/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/787,029

Applicant(s)

HIRANO, TAKUYA

Examiner

Ponnoreay Pich

Art Unit

2135

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 December 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1 and 15-24 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1 and 15-24 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claims 2-14 were cancelled. Claims 1 and 15-24 are pending.

Response to Arguments

In regards to one of applicant's arguments, which is a response to the examiner's 112, second paragraph rejections set forth in the prior office action, applicant argued that with regard to item 46, it is believed that the term "single photon or so" is definite (see applicant's remarks, page 17). The examiner respectfully disagrees. Item 46, which applicant referred to, rejected claim 24 as being indefinite because claim 24 recited "a single photon or so" and the examiner stated that it is unclear how many photons are encompassed by "or so". The examiner respectfully maintains this rejection because the metes and bounds of the claim cannot reasonably be determined by one of ordinary skill in the art. Applicant's specification sets forth no criteria for "or so" that one of ordinary skill can use to judge how many photons are encompassed by the phrase. One can interpret the phrase as meaning any number of photons above one; zero photons; two photons, but no more than two; etc. Further, applicant's arguments set forth no reason why applicant believes the phrase is definite except to say that it is—attorney's arguments do not replace evidence where evidence is necessary.

The rest of applicant's arguments have also been considered, but are moot in view of new grounds of rejections presented below in response to applicant's amendments, which changes the scope of the claims.

Specification

Applicant's amendments to the specification and abstract have been noted. The examiner notes that the amendments introduce the new matter that the quantum cipher communication system utilizes an optical balanced homodyne detector. The examiner submits that the use of an optical balanced homodyne detector was not disclosed, inherently or otherwise, by the originally filed application since a different type of detector could have been used (i.e. heterodyne detectors), thus the amendments by applicant concerning the use of an optical balanced homodyne detector is considered new matter. As per 37 CFR 1.53(b), applicant's amendments may not introduce new matter into an application after its filing date. The examiner notes that the first instance of an optical homodyne detector being recited in the current application was via an amendment to the claims on 6/20/2005 by applicant. The examiner had noted in the prior office action that such a detector was not disclosed in the applicant's specification. The examiner is willing to enter the amendment into record, but as per MPEP 706.02(V)(B), only the limitations that were fully supported by the original specification at the time the application was filed will be given the benefit of the effective filing date of the application. Any limitations dealing with the optical balanced homodyne detector in the claims will not be given the benefit of the effective filing date of the application as originally filed and the effective filing date to be considered with regards to those limitations will instead be the date in which the limitation was first introduced to the current application by applicant, which is 6/20/2005.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

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The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims ^{1, 15-24} are rejected under 35 U.S.C. 112, second paragraph, as being

indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

1. Claims 1 and 15-24 refers to "said <item>" and "the <item>". It is unclear if applicant meant for "said <item>" and "the <item>" to refer to the same items. For example, claim 15 refers to "the sender's apparatus", while claim 16 refers to "said sender's apparatus". The inconsistent use of "said" and "the", especially between claims that depend on each other, seems to imply that what is being referred to by "the" and "said" are separate items. If applicant meant for what is being referred to by "said" and "the" to refer to the same item, then the examiner respectfully requests applicant consistently use either "said" or "the" in referring to the same item. If applicant meant for "said" and "the" to refer to separate items, confirmation by applicant is respectfully requested and the examiner respectfully suggests amending the claim language to make this clearer.
2. Claim 1 recites "its" in line 3. It is unclear what "its" is referring to. The examiner respectfully suggests not using pronouns in referring to items in the current set of claims since doing so renders the claim language indefinite and the scope of the claim cannot be determined. This is one example of where the use of pronouns renders the meaning of the claim indefinite. The examiner suggests applicant double check all the claims for similar pronoun usage and make similar

corrections in case the examiner inadvertently missed any other usage of pronouns in the claims.

3. Claim 1 recites "the signal light" and "the reference light" in line 6, which lacks antecedent basis.
4. Claim 1 recites "the detector" in line 8, which lacks antecedent basis.
5. Claim 1 recites "said difference signals" and "said phase differences" in line 11, which lacks antecedent basis. The examiner notes that earlier in the claim only one difference signal was recited and only one phase difference was recited, so it is unclear which other difference signals and phase differences are being referred to in line 11.
6. Claim recites in lines 13-14 "said quantum-mechanical probability distribution of said difference signal", which appears to lack antecedent basis, since the only quantum-mechanical probability distribution earlier recited were of said difference signals and not said difference signal.
7. Claims 15-24 have been amended to depend from claim 1. In the dependent claims a signal light and a reference light are recited. It would appear from the way the claims are written that "a signal light" and "a reference" light do not refer back to the "weak signal light" and the "intense reference light" recited in claim 1. However, the examiner suspects this to not be the case since applicant's specification seems to imply that the signal light and the weak signal light as being the same light and the same holds true for the reference light and the intense reference light (see specification, p4, line 22-p5, line 9).

8. Claim 15 has been amended to depend from claim 1. Claim 15 as recited is directed towards further describing the limitations of the quantum cipher communication system recited in claim 1. It is unclear if what is recited beginning on line 23 of claim 15 is meant to further characterize the quantum cipher communication system also or if everything after line 22 of claim 15 merely recite an intended use for the quantum cipher communication system. As currently worded, the limitations appear to merely recite an intended use for the quantum cipher communication system. Applicant may wish to double check the wording of the claim beginning on line 23 if applicant meant what is recited therein to be more than merely intended use language. The examiner respectfully suggests applicant double check the wording in all the current set of claims for any language that might cause one to question whether the limitation is merely indicating intended use. The examiner notices several instances of such language and it is highly likely that the examiner might inadvertently miss some if the examiner were to attempt to list them all out, i.e. several wherein clauses and limitations which states that an item is **for** some purpose without saying that the purpose has to be carried out can give rise to question of whether what follows "wherein" and "for" should be given patentable weight since what is recited after either does not appear to necessary characterize the system or merely recites an intended use for something which characterizes the system.
9. Claims 16-17 have been amended to depend from claim 15. It would appear from the way claims 16-17 are written that several limitations are repeated. It is

unclear if applicant meant to repeat those limitations and imply that the system has more than one of those limitations or if applicant instead meant to further define limitations that were already recited in claim 15. For instance, in claim 15, it is recited that the sender's apparatus comprise "a light source for a laser beam". In claim 16, said sender's apparatus is recited as comprising "a light source for a laser beam". Claim 17 recites said sender's apparatus comprises "a light source for a linearly polarized pulsed light". The examiner suspects that applicant may have accidentally repeated such limitations and meant to further define other limitations, i.e. in claim 17 it seems like it would make more sense to further define the laser of claim 15 as a linearly polarized pulsed light.

Applicant's specification seems to indicate that instead of there being multiple lasers, that there is one laser and in one embodiment of applicant's invention, the laser is a polarized pulsed light (see p23 and Fig 6 of applicant's specification).

Other examples of indefiniteness introduced by applicant's amendments exists: for example, claim 15 recites "a beam splitting means for splitting said laser beam into a signal light and a reference light". Claim 16 recites "a beam splitter for splitting said laser beam into a signal light and a reference light". It would appear that the beam splitter in claim 16 is not necessarily the beam splitting means recited in claim 15, but the examiner suspects this to be a mistake and that applicant instead meant to define in claim 16 that the beam splitting means in claim 15 is a beam splitter. Further, it should be apparent that the claims are further rendered indefinite for several other reasons due to applicant's

amendment. Since claim 16 now depends from claim 15, at least two laser beams are recited, i.e. see line 6 of claim 15 and line 6 of claim 16. It is therefore indefinite which laser being is being referred to when "said laser beam" is recited, i.e. line 7 of claim 16. It is indefinite which signal light and reference light is being referred to by "said signal light" and "said reference light", etc. Applicant is urged to double check the claims to find any other 112, second paragraph problems brought about by applicant's amendment that the examiner may have inadvertently missed since some of the claims are so lengthy.

10. Claim 17 recites "the optical fiber" in line 20, which lacks antecedent basis.

11. Claim 19 recites "the phase modulations designed to transmit privacy keys". The metes and bounds of claim 19 cannot be determined because claim 19 depends from any one of claims 15-17, which recites many phase modulations. It is unclear which of the phase modulations recited in claims 15-17 were designed to transmit privacy keys or if applicant meant to refer to all the phase modulations as being designed to transmit privacy keys. The phrase "such a phase modulation" also renders the claim indefinite because it is unclear to which phase modulation is being referred to by "such a phase modulation". The phrase "so imparted" is also indefinite because it is unclear what is encompassed by "so imparted".

12. Claim 20 recites "such phase modulations". It is unclear which phase modulations are encompassed by the phrase "such phase modulations". The

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phrase “so imparted” in claim 20 is also indefinite because it is unclear what is encompassed by “so imparted”.

13. Claim 21 recites “the error rate”, which lacks antecedent basis.

14. Claim 22 recites “said difference signal”, which lacks antecedent basis.

15. Claim 23 recites “the light”, which lacks antecedent basis. Any one of claims 15-17 as currently amended, from which claim 23 depends, recites many different types of lights. It is unclear to which light “the light” in claim 23 is referring.

16. Claim 24 recites “a single photon or so” in line 3. The metes and bounds of the claim cannot be determined since it is unclear how many photons are encompassed by “or so”.

17. Any claims not specifically addressed are rejected by virtue of dependency.

18. Though the scope and meaning of the current set of claims cannot be fully understood due to the above 112, second paragraph errors, to avoid piece-meal examination of the current application, the examiner will attempt to apply art rejection to the current set of claims to the best extent that the scope and meaning of the claims can be understood. Applicant is strongly encouraged to double check all the claims for any other 112, second paragraph problems that the examiner may have missed or did not explicitly point out so that there is no delay in allowance should the limitations in the claims be found allowable over the prior art.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 15-16, and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bennett (US 5,307,410) in view of Kahn et al (US 5,007,106).

Claim 1:

Bennett discloses:

1. It uses a phase difference between a weak signal light which is so weak that a change in its quantum mechanical state is detectable and an intense reference light for communicating a privacy key, wherein said difference is produced by a sender and a recipient adding a phase on the signal light or the reference light (col 5, lines 53-60; col 6, lines 30-37; col 7, lines 1-18; col 8, lines 6-28; and col 10, lines 3-11).
2. It has a detector which detects said phase difference as a difference signal of the detector (col 7, lines 1-13).
3. Wherein an eavesdropping is detected by the recipient measuring a change in said quantum-mechanical probability distribution of said difference signal, which is produced by the eavesdropping operation (col 7, lines 37-43 and col 9, lines 48-60).

Bennett does disclose not the following limitations, which are disclosed by Kahn:

1. The detector is an optical balanced homodyne detector (col 2, lines 55-58).
2. Wherein said phase difference is assigned to bit 0 or bit 1 by comparing said difference signal with threshold values which are determined from a quantum-mechanical probability distribution of said difference signals obtained from a set of said phase differences assigned bit 0 or bit 1 (col 2, line 61-col 3, line 6).

At the time applicant's invention was made, it would have been obvious to one of ordinary skill in the art to modify Bennett's invention according to the limitations recited in claim 1 in light of Kahn's teachings. One of ordinary skill would have been motivated to do so because Bennett discloses that the choice of a photodetector is an important design consideration (col 8, lines 45-46) and incorporating Kahn's teachings of a homodyne detector into Bennett's system would increase Bennett's likelihood of detecting an eavesdropper since homodyne detectors offer the best receiver sensitivity among all binary signaling techniques employing single-bit decisions.

Claim 15:

Bennett further discloses the system comprises a sender's apparatus (Fig 2), a recipient's apparatus (Fig 3) and a transmission path connecting between the sender's apparatus and the recipient's apparatus (Fig 2 and Fig 3, items 18, 20, and 22 in each figures), and is characterized in that:

1. The sender's apparatus comprises of:
 - a. A light source for a laser beam (Fig 2, item 28).

- b. A beam splitting means for splitting said laser beam into a signal light and a reference light (Fig 2, items 30 and 34).
- c. A phase modulation means making phase change for every light which is either of said signal light or said reference light (Fig 2, item 36).
- d. A light attenuation means for attenuating said signal light intensity (Fig 2, items 32).

2. The recipient's apparatus comprises of:

- a. A phase modulation means making a phase change for every light which is either of said signal light or said reference light transmitted from the sender's apparatus through the transmission path (Fig 3, item 68).
- b. A superimposing means for superimposing said signal light and said reference light, either of which is phase changed by said phase modulation means of the recipient's apparatus (col 6, lines 56-64).
- c. A pair of photoconductive diodes for converting two output lights from said superimposing means into respective electric signals (col 8, line 61-col 9, line 2).
- d. An amplifying means for amplifying a difference signal between said electric signals (Fig 3, item 74).

Claim 16:

Bennett further discloses:

1. Said sender's apparatus comprises of:

- a. A light source for a laser beam (Fig 2, item 28).

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- b. A beam splitter for splitting said laser beam into a signal light and a reference light (Fig 2, items 30 and 34).
- c. A movable mirror making a phase change for every signal light (Fig 2, items 52 and 53).
- d. A light attenuator for attenuating said signal light intensity (Fig 2, item 32), said transmission path comprising a pair of paths for transmitting said signal light and said reference light respectively (Fig, items 28, 20, and 22).

2. Said recipient's apparatus comprises of:

- a. A moveable mirror making a phase change for every said reference light transmitted from the sender's apparatus through one of the path (Fig 3, items 78 and 79).
- b. A beam splitter for superimposing said signal light transmitted from the sender's apparatus through the other path of transmission and said reference light phase changed by said moveable mirror of the recipient's apparatus (Fig 3, item 66).
- c. A pair of photoconductive diodes for converting two output lights from said beam splitter into respective electric signals (col 8, line 61-col 9, line 2).
- d. A charge sensitive amplifier for amplifying a difference signal between said electric signals (Fig 3, item 74).

3. Said set of phase changes are 0, 90, 180, and 270 degrees (col 8, lines 33-41).

Claim 24:

Bennett further discloses the system is characterized in that said signal light has a typical intensity corresponding to a signal photon or so, and said reference light has a typical intensity corresponding to photons as large as 10 millions in number (col 5, lines 47-60).

Claims 19-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bennett (US 5,307,410) in view of Kahn et al (US 5,007,106) and further in view of Bethune et al (US 6,188,768).

Claim 19:

Bennett does not disclose the system is characterized in that "in addition to the phase modulations designed to transmit privacy keys, such a phrase modulation is so imparted as having a value later determined for making a correction for a fluctuation of the difference in optical path between said reference light and said signal light which develops by reason of an external cause". However, Bethune meets recited the limitation (col 7, lines 32-46).

At the time applicant's invention was made, it would have been obvious to one of ordinary skill in the art to further modify Bennett's system according to the limitations recited in claim 19, in light of Bethune's teachings. One of ordinary skill would have been motivated to do so because the fluctuation in the difference signal by an external cause determines if an eavesdropper has gained access to the communication.

Claim 20:

Bennett does not disclose the system is characterized in that "such phase modulations are so imparted as including those for transmitting privacy keys and those with values later determined are randomly repeated". However, Bethune meets the recited limitation (col 6, lines 6-28).

At the time applicant's invention was made, it would have been obvious to one of ordinary skill in the art to further modify Bennett's system according to the limitations recited in claim 20, in light of Bethune's teachings. One of ordinary skill would have been motivated to do so because introducing a randomness into the transmission process for key generation makes the generated key harder to guess by an attacker.

Claim 21:

Bennett does not disclose the system is characterized in that "eavesdropping is detected on the basis of an increase in the error rate of said difference signal". However, Bethune discloses the limitation (col 5, lines 64-67 and col 6, lines 1-5).

At the time applicant's invention was made, it would have been obvious to one of ordinary skill in the art to further modify Bennett's system according to the limitations recited in claim 21, in light of Bethune's teachings. One of ordinary skill would have been motivated to do so because increases in errors are usually an indication of an intruder in a system.

Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bennett (US 5,307,410) in view of Kahn et al (US 5,007,106) and further in view of Bartelt et al ("The Wigner Distribution Function—An Alternative Signal Representation in Optics").

Claim 22:

Bennett does not disclose the system is characterized in that "eavesdropping is detected on the basis of a change in a Wigner distribution function that indicates a quantum mechanical state of said difference signal. However, Bartelt discloses the limitation (p260).

At the time applicant's invention was made, it would have been obvious to one of ordinary skill in the art to further modify Bennett's system according to the limitations recited in claim 22, in light of Bartelt's teachings. One of ordinary skill would have been motivated to do so because the Wigner distribution function is an effective way to determine if the signal has been eavesdropped.

Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bennett (US 5,307,410) in view of Kahn et al (US 5,007,106) and further in view of Lee (US 5,665,423).

Claim 23:

Bennett does not explicitly disclose the system is characterized I that "for said pair of photoconductive diodes, use is made of silicon photoconductor diodes when the light has a wave length of 600 nm to 900 nm, and of InGaAs photoconductor diodes

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when the light has a wave length of 100nm to 1500 nm. However, Lee discloses the limitation (col 1, lines 26-38).

At the time applicant's invention was made, it would have been obvious to one of ordinary skill in the art to further modify Bennett's invention according to the limitations recited in claim 23. One of ordinary skill would have been motivated to do so because the frequency of photodetectors depends on the material used (Lee, col 1, lines 26-27).

Allowable Subject Matter

Claims 17-18 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

As per claim 17, the examiner did not find teachings in the prior art of the combination of limitations as currently recited in amended claim 17. Claim 18 depends from claim 17.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not


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mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ponnoreay Pich whose telephone number is 571-272-7962. The examiner can normally be reached on 9:00am-4:30pm Mon-Fri.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kim Vu can be reached on 571-272-3859. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Ponnoreay Pich
Examiner
Art Unit 2135

KIM VU
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2100

PP